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09/420,157 10/18/99 FILAS

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DOCKET ADMINISTRATOR
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EXAMINER

ROY, S

ART UNIT

PAPER NUMBER

2879

DATE MAILED:

08/17/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/420,157

Applicant(s)

FILAS ET AL.

Examiner

Sikha Roy

Art Unit

2879

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 October 1999.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) _____ is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3.
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-18 drawn to, electron field emission device classified in class 313, subclass 355.
- II. Claims 19-35, drawn to process for fabricating the field emission device, classified in class 445, subclass 24.

Inventions of Group I and Group II are related as product and process of making it. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the product as claimed can be made by another and materially different process. For example, the product as claimed, can be made as follows: aligning the nanowires on the support can be done electrostatically.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Mr. Scott Rittman on 08/2/01 a provisional election was made without traverse to prosecute the invention of group I, claims 1-18. Affirmation of this election must be made by applicant in replying to this Office action.

Claims 24-25 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a petition under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1- 14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,250,984 to Jin et al. in view of U. S. Patent No. 5,973,444 to Xu et al.

Regarding claims 1,10,11 and 16 Jin et al. disclose (column 3 lines13-15,21-25) field emitter structures comprising exposed carbon nanowires(nanotubes) protruding from a conductive material, the extent of protrusion being at least twice the average diameter of the nanowires. The composite structure consisting of carbon nanotubes and conductive material (metal matrix) is utilized in order to have desired field

concentration. The applicants' admitted prior art discloses (page 4 lines 23-25) nanowires with average diameters ranging from 0.5 nm to about 50 nm and aspect ratio about 10,000, have the lengths ranging from 5 μ m to 500 μ m which is within the claimed range of 0.1 μ m to about 10000 μ m. The metal/nanotube composite material offers relatively stable electrical contact. It is further noted that the multitude of emitters are formed on the substrate (Fig.9) in an X-Y matrix array.

Claim 1 differs from Jin et al. in that Jin et al. do not exemplify the magnetic material partially coating the nanowires.

Xu et al. in analogous art of carbon fiber –based field emission devices disclose (column 3 lines 42, column 5 lines 19-22) carbon fiber emitters grown on patterned substrate material. The substrate (12 FIG. 1) comprises of patterned growth surface (14) with Fe, Ni, Cr, Mn which are magnetic material. The nanowires (20) protruding from this composite material containing magnetic material are hence partly coated with the metals. This patterning provides the ability to fabricate arrays of individual field emitters.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the nanowires disclosed by Jin et al. by the ones partly coated with magnetic material as taught by Xu et al. for fabricating the arrays of emitters.

Referring to claim 2, Jin et al. disclose (column 3 lines 11,12) the device can be used as field emission displays.

Referring to claim 3, Jin et al. disclose (column 4 lines 50-53) the ends of the nanotubes being freshly broken provide even smaller radii of curvature for enhanced field concentration and electron emission.

Referring to claim 4 and 5, Xu et al. only teach that nanowires protruding from the composite material patterned with metal film are partially coated with the material. Xu et al. do not exemplify the volume percentage of magnetic material comprising the coating of the nanowires. It would have been obvious to one having ordinary skill in the art at the time the invention was made to specify the magnetic material comprising less than 0.95 or 0.75 volume % of the coated nanowires, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F 2d 272, 205 USPQ (CCPA 1980).

Referring to claims 6 and 7, Jin et al. disclose (column 10 lines 45,46) that the advantageously protrusion height of the nanowires is at least 10 times the nanotube diameter. It is noted (column 5 line 56) that single wall nanotubes exhibit typical diameter on the order of 1 to 5 nm and hence the protrusion heights may vary from 10 to 50 nm. Jin et al. teach that the protrusion height is preferably at least 100nm.

Referring to claim 8, Jin et al. disclose (column 7 lines 59-66) the incorporation of a relatively large volume fraction of the nanowires. The volume of the nanowires is typically at least 10^{-7} volume fraction advantageously 10^{-5} volume fraction of the matrix to a depth of at least 2 μm from the surface from which nanowires protrude. It would have been obvious to one having ordinary skill in the art at the time the invention was made to specify the composite material comprising less than at least volume % of

the nanowires, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F 2d 272, 205 USPQ (CCPA 1980).

Referring to claim 9 Jin et al. disclose (column 5 lines 20, 21) the average variation in protrusion height is advantageously less than a factor of two which covers the limitation of the variation less than 40%.

Referring to claims 12-14, Jin et al. disclose a multi layer apertured grid structure with at least two and advantageously four grid conductors. The protruding nanowires from the surfaces of the substrate (Fig. 5D) provide arrayed emitter structures. An apertured grid structure is formed in front of the nanotube emitter structure separated by electrically insulating layer. As illustrated in FIG. 9 four layers of grid conductors 100A, 100B, 100C 100D separated by insulators define the aligned aperture and allow electron beams to be focused during traveling.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,250,984 to Jin et al. in view of in view of U. S. Patent No. 5,973,444 to Xu et al. and further in view of applicants' admitted prior art (page 4 lines 2-4, 16-19).

Referring to claim 16, Jin et al. disclose (column 6, lines 9, 10, 34) the nanowires as carbon nanotubes and mixing of nanotubes with Ni, Fe metal powders. This would result in nanotubes having magnetic material present inside.

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Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,250,984 to Jin et al. in view of U. S. Patent No. 5,973,444 to Xu et al. and further in view of U. S. Patent No. 5,456,986 to Majetich et al.

Majetich et al. in relevant art of magnetic metal nanoparticles disclose (column 5 lines 9-13) the nanoparticles comprising of paramagnetic or ferromagnetic compound, the ferromagnetic compound selected from the group consisting of iron, cobalt, nickel. Majetich et al further teach (column 6 lines 16-18) that the nanoparticles packed with paramagnetic or ferromagnetic material can be segregated by magnetic moment per volume by varying magnetic field.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to specify the coating of the composite structure comprising of Fe, Ni, Co as ferromagnetic group as taught by Majetich et al. so that the nanowires grown on the composite material can be segregated by applying varying magnetic field.

Regarding claim 18, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the structure from the group comprising near-superparamagnetic and superparamagnetic, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice.

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Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following patents are cited to further show the state of the art with respect to field emission devices with nanostructured emitters.

U. S. Patent No. 5,726,524 to Debe.

U. S. Patent No. 6,020,677 to Blanchet-Fincher et al.

U. S. Patent No. 6,232,706 to Dai et al.

JP 2000208028 to Nakayama.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sikha Roy whose telephone number is (703) 308-2826. The examiner can normally be reached on Monday-Friday 8:00 a.m. – 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar D. Patel can be reached on (703) 305-4794. The fax phone number for the organization is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

S.R.

Sikha Roy
Patent Examiner
Art Unit 2879



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